Amendments to the Claims:

   This listing of the claims will replace all prior versions, and listings, of

claims in the application:

     Listing of Claims:

    1-2. **(canceled)**

    3. **(original)** The method according to claim 38, wherein the correlation is

approximately equal to a ratio of an area of a logical AND between a figure obtained by

moving one of the temporally adjacent first figures on the basis of a motion vector

thereof and the other of the temporally adjacent first figures to an area of the one or the

other of the temporally adjacent first figures.

    4-6. **(canceled)**

    7. **(original)** The apparatus according to claim 39, wherein the correlation

of the step (b) is approximately equal to a ratio of an area of a logical AND between a

figure obtained by moving one of the temporally adjacent first figures on the basis of a

motion vector thereof and the other of the temporally adjacent first figures to an area of

the one or the other of the temporally adjacent first figures.

    8-12. **(canceled)**

    13. **(currently amended)** A method of tracking moving objects in time-

series pictures ~~with~~ by processing the pictures <u>using a processor</u>, each picture being

divided into blocks, each block consisting of a plurality of pixels, wherein in a case

where an <u>object-identification</u> ~~identification~~ code of moving object is assigned in a unit of

block, and a motion vector of moving object is determined in a unit of block, <u>and</u>

wherein object-identification codes of a plurality of moving objects on a picture at a time

t1 have been determined, the method, using the processor, comprising the steps of:

~~(a) estimating a motion vector from a block-size region in a picture at a~~

~~time t1 to a region of interest in a picture at a time t2 as MV, and estimating an~~

~~identification code of the block of interest as ID;~~

~~(b) determining a correlation-related amount including an absolute value of~~

~~a difference between the estimated motion vector MV of the block of interest and a~~

~~motion vector of at least one, having an identification code equal to ID, of blocks~~

~~surrounding the block of interest in the picture at the time t2; and~~

~~(c) determining a value of an estimation function including the correlation-~~

~~related amount for each first region moved within a predetermined range, and~~

~~determining the motion vector MV and the identification code on the basis of an~~

~~approximately-optimum value of the estimation function.~~

determining each object-identification code and moving vector as

approximate values of each of the blocks on a picture at a time t2 on the basis of a first

estimation function,

determining a value of a second estimation function using the approximate

values; and

determining each object-identification code and moving vector as a

solution of each of the blocks on the basis of an approximately-optimum sum of the first

and second estimation functions,

wherein the approximately-optimum sum is obtained by changing the approximate values within a given range;

wherein the first estimation function has the sum of a sub-estimation function for determining a moving vector by block matching between a current block on the picture at the time t2 and a region on the picture at the time t1 and a sub-estimation function for determining an object-identification code of the current block on the basis of a count of pixels belonging to the same object-identification code within the region,

wherein the second estimation function includes respective absolute values of differences between the motion vector MV between the current block and the region and a motion vector of each of blocks around the current block, each of the blocks having the same object-identification code as that of the current block, and takes a more optimum value when the sum of the absolute values is smaller.

14. **(currently amended)** The method according to claim 13, wherein ~~the correlation-related amount of the step (c)~~ the second estimation function includes ~~is expressed by~~ $\Sigma|MV\text{-}MV_{neighbor}|/L$, where $MV_{neighbor}$ denotes a motion vector of a block having the same object-identification code ~~as the identification code~~ ID of the current block ~~of interest~~, within blocks surrounding the current block ~~of interest~~, Σ denotes a sum over the blocks having said same object-identification code ID, and L denotes a number of the blocks having said same object-identification code ID.

15. **(currently amended)** An apparatus for tracking moving objects in time-series pictures, comprising:

a storage device for storing the time-series pictures and a program;

and a processor coupled to the storage device, wherein the program make the processor read and process the time-series pictures to track the moving objects in the pictures, and by the processing, each picture is divided into blocks, each block consisting of a plurality of pixels, in a case where an <u>object-identification</u> ~~identification~~ code of moving object is assigned in a unit of block, and a motion vector of moving object is determined in a unit of block, <u>and wherein object-identification codes of a plurality of moving objects on a picture at a time t1 has been determined,</u> the program comprising the step of:

(a) estimating a motion vector from a block-size region in a picture at a time t1 to a region of interest in a picture at a time t2 as MV, and estimating an identification code of the block of interest as ID;

(b) determining a correlation-related amount including an absolute value of a difference between the estimated motion vector MV of the block of interest and a motion vector of at least one, having an identification code equal to ID, of blocks surrounding the block of interest in the picture at the time t2; and

(c) determining a value of an estimation function including the correlation-related amount for each first region moved within a predetermined range, and determining the motion vector MV and the identification code on the basis of an approximately-optimum value of the estimation function.

<u>determining each object-identification code and moving vector as approximate values of each of blocks on a picture at a time t2 on the basis of a first</u>

estimation function, and determining a value of a second estimation function using the approximate values;

determining each object-identification code and moving vector as a solution of each of the blocks on the basis of an approximately-optimum sum of the first and second estimation functions, wherein the approximately-optimum sum is obtained by changing the approximate values within a given range;

wherein the first estimation function has the sum of a sub-estimation function for determining a moving vector by block matching between a current block on the picture at the time t2 and a region on the picture at the time t1 and a sub-estimation function for determining an object-identification code of the current block on the basis of a count of pixels belonging to the same object-identification code within the region,

wherein the second estimation function includes respective absolute values of differences between the motion vector MV between the current block and the region and a motion vector of each of blocks around the current block, each of the blocks having the same object-identification code as that of the current block, and takes a more optimum value when the sum of the absolute values is smaller.

16**. (currently amended)** The method according to claim 15, wherein ~~the correlation-related amount of the step (c)~~ the second estimation function includes ~~is expressed by~~ $\Sigma|MV\text{-}MV_{neighbor}|/L$, where $MV_{neighbor}$ denotes a motion vector of a block having the same object-identification code ~~as the identification code~~ ID of the current block ~~of interest~~, within blocks surrounding the current block ~~of interest~~, Σ denotes a sum over the blocks having said same object-identification ~~identification~~ code ID, and L

denotes a number of the blocks having said same object-identification ~~identification~~

code ID.

17-20. **(canceled)**

21. **(currently amended)** An apparatus for tracking moving objects in

time-series pictures, comprising:

a storage device for storing the time-series pictures and a program;

and a processor coupled to the storage device, wherein the program make

the processor read and process the time-series pictures to track the moving objects in

the pictures, and by the processing, each picture is divided into blocks, each block

consisting of a plurality of pixels, the program comprising the step of:

(b1) determining motion vectors of respective blocks in a picture at a time

t2 through the use of block matching between a picture at a time t1 and the picture at

the time t2, without discriminating between the background image and moving objects;

(b2) determining motion vectors of blocks, which are not determined at the

step (b1), by estimating the motion vectors through the use of the method according to

any one of ~~claims 9,~~ claims 13 or 14; and

(b3) assigning the same identification code to adjacent blocks if an

absolute value of a difference between motion vectors of the adjacent blocks is less

than a predetermined value.

22-23. (**canceled**)

24. **(currently amended)** The method according to 42, wherein each of

the first and second regions ~~of interest~~ of the step (a) corresponds to one block.

25. **(currently amended)** The method according to 42, wherein the object map of the step (a) is a new object map, and at the step (b), the ~~two regions~~ region of interest is are moved in the negative direction of ~~the~~ their motion ~~vector~~vectors, respectively.

26. **(original)** The method according to 42, wherein the number of the plurality of object maps is kept constant by updating an oldest object map with a newest object map.

27. **(canceled)**

28. **(currently amended)** The method according to ~~claim 27~~ claim 42, wherein, the first region at the time t1 is a single cluster including adjacent blocks and if a plurality of peaks are present in a histogram of absolute values of motion vectors of the blocks ~~for including adjacent blocks having motion vectors~~, an interval between the times t1 and t2 is determined on the basis of a speed difference between the peaks.

29. **(currently amended)** The method according to ~~claim 27~~ claim 42, wherein each time the interval between the times t1 and t2 is increased, it is determined whether or not the absolute value of the difference between the ~~respective~~ first and second fast-forward motion vectors ~~of the two adjacent regions of interest on the object map of the time t2~~ is more than the predetermined value, and wherein if the interval is less than a predetermined maximum value and if the absolute difference is more than the predetermined value, then the ~~two adjacent~~ first and second regions ~~of interest~~ are recognized as different moving objects to each other.

30-31. **(canceled)**

32. **(currently amended)** The method according to ~~43~~ to claim 42, wherein <u>each of</u> the <u>first and second</u> regions ~~of interest~~ of the step (a) corresponds to one block.

33. **(currently amended)** The method according to ~~43~~ to claim 42, wherein the object map of the step (a) is a new object map, and at the step (b), the <u>two</u> ~~region~~<u>regions</u> ~~of interest is~~ <u>are</u> moved in the negative direction of ~~the~~ <u>their</u> motion ~~vector~~<u>vectors, respectively</u>.

34. **(currently amended)** The method according to ~~43~~ to claim 42, wherein the program further comprises the step of:

keeping the number of the plurality of object maps constant by updating an oldest object map with a newest object map.

35. **(canceled)**

36. (**currently amended**) The apparatus according to ~~claim 35~~ <u>claim 43,</u> <u>wherein the first region at the time t1 is a single cluster including adjacent blocks and</u>, wherein the program further comprises the step of:

if a plurality of peaks are present in a histogram of absolute values of motion vectors <u>of the blocks</u> ~~for a single cluster including adjacent blocks having motion vectors~~, determining an interval between the times t1 and t2 on the basis of a speed difference between the peaks.

37. **(currently amended)** The apparatus according to ~~claim 35~~ <u>claim 43</u>, wherein the program further comprises the step of:

each time the interval between the times t1 and t2 is increased, determining whether or not the absolute value of the difference between the ~~respective~~ first and second fast-forward motion vectors ~~of the two adjacent regions of interest on the object map of the time t2~~ is more than the predetermined value; and

if the interval is less than a predetermined maximum value and if the absolute difference is more than the predetermined value, recognizing the ~~two adjacent~~ first and second regions ~~of interest~~ as different moving objects to each other.

38. **(currently amended)** A method of tracking moving objects in time-series pictures ~~with~~ by processing the pictures using a processor, each picture being divided into blocks, each block consisting of a plurality of pixels, wherein in a case where an identification code of moving object is assigned in a unit of block, and a motion vector of moving object is determined in a unit of block, the method being implemented using the processor, comprising the steps of:

(a) for each of N (N$\geq$2) consecutive pictures within the time-series pictures, assigning the same identification code to adjacent blocks if an absolute value of a difference between motion vectors of the adjacent blocks is less than a predetermined value, thereby allowing different identification codes to be assigned to different moving objects overlapping in a picture;

(b) judging whether or not:

a first object consisting of a group of blocks assigned a first identification code and a second object consisting of a group of blocks assigned a second identification code are in contact with each other in each of the N consecutive pictures;

and a correlation between the first objects in every temporally adjacent pictures in the N consecutive pictures is more than a predetermined value;

(c) tracking the first and second objects backward in time after the judgment of the step (b) is positive.

39. **(original)** An apparatus for tracking moving objects in time-series pictures, comprising:

a storage device for storing the time-series pictures and a program;

and a processor coupled to the storage device, wherein the program make the processor read and process the time-series pictures to track the moving objects in the pictures, and by the processing, each picture is divided into blocks, each block consisting of a plurality of pixels, an identification code of moving object is assigned in a unit of block, and a motion vector of moving object is determined in a unit of block, the program comprising the step of:

(a) for each of N ($N \geq 2$) consecutive pictures within the time-series pictures, assigning the same identification code to adjacent blocks if an absolute value of a difference between motion vectors of the adjacent blocks is less than a predetermined value, thereby allowing different identification codes to be assigned to different moving objects overlapping in a picture;

(b) judging whether or not:

a first object consisting of a group of blocks assigned a first identification code and a second object consisting of a group of blocks assigned a second identification code are in contact with each other in each of the N consecutive pictures;

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and a correlation between the first objects in every temporally adjacent pictures in the N consecutive pictures is more than a predetermined value; and

(c) tracking the first and second objects backward in time after the judgment of the step (b) is positive.

40. **(original)** A method according to any one of claims 13 or 14, wherein a background image is regarded as a moving object.

41. **(currently amended)** A method of tracking moving objects in time-series pictures with processing the pictures by a processor, the method, using the processor, comprising the steps of:

(a) dividing each picture into blocks, each block consisting of a plurality of pixels; and

(b) with regarding a background image as a moving object, assigning an identification code of moving object in a unit of block and determining a motion vector of the moving object in a unit of block;

wherein the step (b) comprises the steps of:

(b1) determining motion vectors of respective blocks in a picture at a time t2 through the use of block matching between a picture at a time t1 and the picture at the time t2, without discriminating between the background image and moving objects;

(b2) determining motion vectors of blocks, which are not determined at the step (b1), by estimating the motion vectors through the use of the method according to any one of claims 9, claims 13 or 14; and

(b3) assigning the same identification code to adjacent blocks if an absolute value of a difference between motion vectors of the adjacent blocks is less than a predetermined value.

42. **(currently amended)** A method of tracking a moving object in time-series pictures with processing the pictures by a processor, each picture being divided into blocks, each block consisting of a plurality of pixels, wherein a plurality of object maps of different times have been stored, each object map having motion vectors of the moving object in a unit of block, the method, using the processor, comprising the steps of:

(a) determining a respective motion vectors of a first and second regions adjacent to each other of interest for on one at time t1 of the plurality of object maps; and

(b) determining a respective motion vectors of a two regions , to which the first and second regionregions of interest is are moved with using the determined motion vectors, respectively, in positive or negative direction thereof, on the basis of an object map at a time corresponding to completion of the movement of the regionregions,

wherein the moved region is set as a region of interest on the object map of the time corresponding to the completion of the movement of the region, and the step (b) is repeated a plurality of times to track until a time t2 the two regionregions corresponding to the first and second regions, of interest,

wherein at the step (a) or the step (b), for each current region of the two regions, a weighted motion vector average is determined as a motion vector of the

region ~~of interest~~ with using motion vectors of blocks overlapping with the <u>current</u> region ~~of interest~~, where weights given to the respective motion vectors correspond to the number of pixels of respective portions overlapping between the respective blocks and the <u>current</u> region<u>.</u> ~~of interest.~~

<u>the method, using the processor, further comprising the steps of:</u>

<u>obtaining a motion vector from the first region at the time t1 to the corresponding region at the time t2 as a first fast-forward motion vector by accumulating corresponding motion vectors between the times t1 and t2, obtaining a motion vector from the second region at the time t1 to the corresponding region at the time t2 as a second fast-forward motion vector by accumulating corresponding motion vectors between the times t1 and t2; and</u>

<u>recognizing the first and second regions at the time t1 as different moving objects if an absolute value of the difference between the first and second fast-forward motion vectors is more than a predetermined value.</u>

43. **(currently amended)** An apparatus for tracking moving objects in time-series pictures, comprising:

a storage device for storing the time-series pictures and a program;

and a processor coupled to the storage device, wherein the program make the processor read and process the time-series pictures to track the moving objects in the pictures, and by the processing, each picture is divided into blocks, each block consisting of a plurality of pixels, a plurality of object maps of different times have been

stored, each object map having motion vectors of the moving object in a unit of block,

the program comprising the step of:

(a) ~~determining a~~ determining respective motion ~~vector~~vectors ~~of a~~ of first

and second ~~region~~regions adjacent to each other ~~of interest for~~ on one at time t1 of the

plurality of object maps; and

(b) ~~determining a~~ determining respective motion ~~vector~~vectors ~~of a~~ of two

~~region~~regions, to which the first and second ~~region~~regions ~~of interest is~~ are moved with

using the determined motion ~~vector~~vectors, respectively, in positive or negative direction

thereof, on the basis of an object map at a time corresponding to completion of the

movement of the ~~region~~regions,

wherein ~~the moved region is set as a region of interest on the object map~~

~~of the time corresponding to the completion of the movement of the region, and~~ the step

(b) is repeated a plurality of times to track until a time t2 the two ~~region~~regions

corresponding to the first and second regions, ~~of interest,~~

wherein at the step (a) or the step (b), for each current region of the two

regions, a weighted motion vector average is determined as a motion vector of the

region ~~of interest~~ with using motion vectors of blocks overlapping with the current region

~~of interest~~, where weights given to the respective motion vectors correspond to the

number of pixels of respective portions overlapping between the respective blocks and

the current region, ~~of interest.~~

the program further comprising the steps of:

obtaining a motion vector from the first region at the time t1 to the corresponding region at the time t2 as a first fast-forward motion vector by accumulating corresponding motion vectors between the times t1 and t2, obtaining a motion vector from the second region at the time t1 to the corresponding region at the time t2 as a second fast-forward motion vector by accumulating corresponding motion vectors between the times t1 and t2; and

recognizing the first and second regions at the time t1 as different moving objects if an absolute value of the difference between the first and second fast-forward motion vectors is more than a predetermined value.